

An **Extremely Compact Lamp** containing a spiral filament can be coupled directly to an optical fiber.

ment to the window are such that light emitted by the filament can be coupled efficiently to an optical fiber without intervening optics.

The components used for fabricating a lamp of this type are, more specifically, the following:

- The ceramic package is an appropriately sized commercially available leadless chip carrier containing gold contact pads. The package is chosen to

have a contact-pad spacing of about 0.25 in. (≈ 6 mm) so that the filament fits between two of the pads.

- The window is part of a windowed lid for the leadless chip carrier, supplied with a preform made of gold/tin solder. The preform is to be used subsequently in bonding (by soldering) the lid to the leadless chip carrier.
- The filament is formed by chemical etching or laser ablation of a 25- μm -thick sheet of tungsten or a tungsten/rhenium alloy.
- Two commercially available contact-pad brazing preforms made of a silver/copper/indium/titanium alloy that has a liquidus temperature of 715 $^{\circ}\text{C}$ are needed for attaching (by brazing) the filament to two contact pads.

Once the aforementioned components have been prepared, the lamp is assembled as follows:

1. The brazing preforms are placed on two opposing contact pads.
2. The outer ends of the filament are placed on the brazing preforms.
3. The assembly as described thus far is placed in either a vacuum furnace at a pressure of 10^{-7} torr (1.3×10^{-5} Pa) or a furnace containing an inert atmosphere, and heated to ≈ 800 $^{\circ}\text{C}$ or until brazing alloy melts and wets the filament.
4. The assembly is cooled to harden the braze, then the furnace is opened to room air and the assembly is removed from the furnace.
5. Optionally, at this point, the assembly can be placed in a vacuum chamber, wherein the filament can be baked

out by applying operating power to it. The assembly is then removed from the vacuum chamber.

6. A small nick is made in the solder preform on the lid to allow air to escape during step 8.
7. The lid is placed on the ceramic package, held in place by a weight or a clip. The package is placed in a vacuum furnace.
8. The vacuum furnace is pumped down to the desired vacuum for the interior of the lamp.
9. The furnace is heated to the eutectic temperature of the solder to melt and reflow the solder, then is cooled back to room temperature, then opened to air.

Lamps of this type containing tungsten and tungsten/rhenium filaments have been operated in laboratory tests at temperatures up to 2,650 and 2,725 $^{\circ}\text{C}$, respectively. At an input power of ≈ 2 W, each lamp generates a luminous flux of about 1.5 lumens.

This work was done by Margaret Tuma of Glenn Research Center; Joe Collura of the Lighting Innovations Institute; Henry Helvajian of the Aerospace Corp.; and Michael Pocha, Glenn Meyer, Charles F. McConaghy, and Barry L. Olsen of Lawrence Livermore National Laboratory. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17820-1.

Bidirectional Pressure-Regulator System

This system can be used in regenerative fuel cell systems.

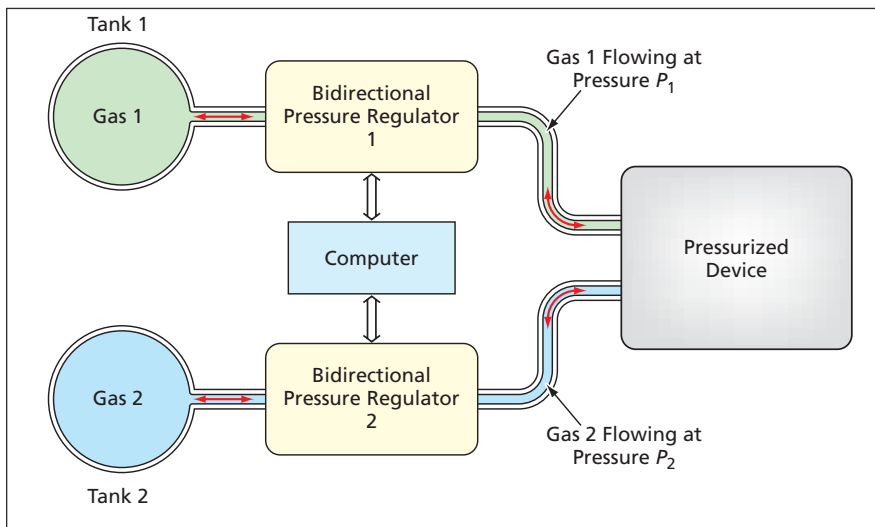
John H. Glenn Research Center, Cleveland, Ohio

A bidirectional pressure-regulator system has been devised for use in a regenerative fuel cell system. The bidirectional pressure-regulator acts as a back-pressure regulator as gas flows through the bidirectional pressure-regulator in one direction. Later, the flow of gas goes through the regulator in the opposite direction and the bidirectional pressure-regulator operates as a pressure-reducing pressure regulator. In the regenerative fuel cell system, there are two such bidirectional regulators, one for the hydrogen gas and another for the oxygen gas. The flow of gases goes from the regenerative fuel cell system

to the gas storage tanks when energy is being stored, and reverses direction, flowing from the storage tanks to the regenerative fuel cell system when the stored energy is being withdrawn from the regenerative fuel cell system. Having a single bidirectional regulator replaces two unidirectional regulators, plumbing, and multiple valves needed to reverse the flow direction. The term "bidirectional" refers to both the bidirectional nature of the gas flows and capability of each pressure regulator to control the pressure on either its upstream or downstream side, regardless of the direction of flow.

The system includes a computer that runs software formulated specifically to control the operation of the bidirectional pressure regulators. Each bidirectional pressure regulator includes the following components:

- A ten-turn needle valve;
- Two pressure sensors on opposite sides (upstream and downstream) of the valve;
- A stepping motor, connected to the shaft of the needle valve, for increasing or decreasing the valve orifice size as needed to decrease or increase the difference between the upstream and downstream pressures;



The Bidirectional Pressure-Regulator System regulates pressures P_1 , P_2 , and $P_2 - P_1$.

- A ten-turn potentiometer for providing valve-position feedback to the software; and
- Interface circuits between the computer and the stepping motor, pressure transducers, and potentiometer.

The software provides a capability for modifying set points for either upstream or downstream pressure during operation to adjust to changing flow condi-

tions, and/or to other changing system conditions, including changing pressure-control requirements. In addition, the software can easily be modified for application to different closed gas-flow systems. The performance of the bidirectional pressure regulator can be modified by the selection of the valve, the pressure transducers, the stepping motor, and the control parameters em-

bedded within the software control code.

In traditional pressure-regulation practice, control of a differential pressure between two gases would typically involve the use of plumbing to couple the pressures of the gases to a differential-pressure-sensing device; such a device is said to be "hardplumbed." In contrast, the bidirectional pressure-regulator system can be said to be "soft-plumbed" because the connection between the pressures of the two gases is made only in software. In the event that the two gases are such as to pose a risk of fire, explosion, or toxicity if allowed to mix, soft plumbing offers an important safety advantage over hard plumbing by eliminating a potential source of leakage and mixing.

This work was done by Kenneth Burke and John R. Miller of Glenn Research Center and Ian Jakupca and Scott E. Sargi of Analex Corp. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17548-1.

Prism Window for Optical Alignment

Prism windows could be generally useful in manufacture of optical instruments.

NASA's Jet Propulsion Laboratory, Pasadena, California

A prism window has been devised for use, with an autocollimator, in aligning optical components that are (1) required to be oriented parallel to each other and/or at a specified angle of incidence with respect to a common optical path and (2) mounted at different positions along the common optical path. The prism window can also be used to align a single optical component at a specified angle of incidence. Prism windows could be generally useful for orienting optical components in manufacture of optical instruments.

Heretofore, for aligning multiple optical components in a large optical assembly for which there is a requirement that no such component completely obstruct the alignment optical path to any other such component, it has been common practice to use a single large-aperture autocollimator or interferometer. However, the sizes of optical assemblies amenable to this alignment practice are limited by

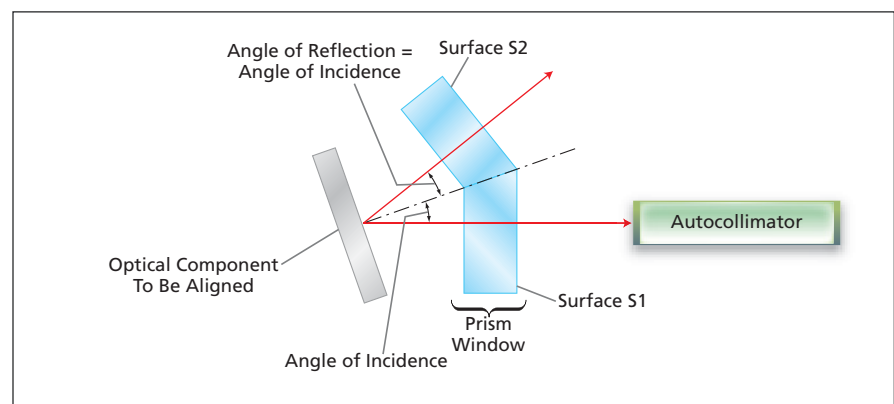


Figure 1. A Prism Window comprising two beam-splitter windows bonded together at a predetermined angle equal to twice a specified angle of incidence is used in conjunction with an autocollimator to align an optical component at the specified angle of incidence.

the sizes of apertures of commercially available autocollimators and interferometers. Moreover, in some cases, it may be necessary to remove some optical components to prevent obscuration of other optical components or to make room for

the autocollimator or interferometer. In contrast, the prism window makes it possible to use an autocollimator or other suitable instrument of narrow aperture to align multiple optical components in a possibly large optical assembly, without